

**BNL LHC Program**  
**Progress Report: February 1, 1999 to February 28, 1999**  
**March 23, 1999**

## **Summary**

Considerable effort was made to resolve the beam tube diameter issue, without success. The discussions included BNL staff from Magnets and Accelerator Physics, US Project Office staff, and exchanges via email with CERN staff. In some locations CERN wishes to use larger diameter beam tubes than have been used previously in RHIC-type magnets, but then cooling of the superconducting coils becomes an issue. The SC Test upgrade project is making better progress as additional manpower becomes available. Good progress continues in Accelerator Physics and Project Status reporting. Trips to CERN by BNL staff, visits to BNL by Project Office staff, scheduled video conferences and numerous email messages kept communications channels wide open.

### **1.2.1. RF Region Dipoles**

A document named "Configuration Descriptions" was distributed at BNL. This document describes each of the magnets BNL will build for the LHC, including the end configurations. The figures need to be put in electronic format for the document to become a CERN Functional Specification.

A specification for LHC beam tubes was created. The release of the spec and the order for tubes is awaiting a final decision on beam tube diameter. A draft specification for LHC vacuum vessels was also created. This will be discussed with CERN.

Plans for the trip to CERN by BNL Staff were finalized. This trip will focus on tooling changes/manufacture. The vacuum vessel draft specification and other LHC issues will also be discussed.

A Preliminary Design Review was held on a shell cover patch welder. This device utilizes existing CQS equipment. The cost of the modifications is not included in the baseline; however, an analysis has shown that tooling costs will be completely offset by production savings. Plans are proceeding toward the completion of the design and fabrication of the new tooling.

#### *In the Design Room:*

- The D4B prototype collaring assembly drawing has been submitted to checking.
- The D4B prototype strain gauge collar assembly design has started.
- Drawings for the D1/D3 collared yoke assembly have been submitted to checking.
- Drawings for the D4B prototype vertical dewar top hat modifications have been submitted to engineering for review.

- Drawings for the shell welding fixture and the rotating fixture (cold mass fixtures #1 and #2) were released to the machine shop for fabrication.
- Drawings for the rotary Mig welding follower and the yoke stacking mandrel were released to the machine shop for fabrication.
- A final design review was held on the prototype coil curing tooling. (Design is complete except for the final assembly drawing.) Drawings have been released to the machine shop for fabrication.
- Drawings for the D2/D4 collaring press modifications have been released to the machine shop for fabrication.

### **1.3.1. Superconductor Testing**

#### *1.3.1.1 Tooling and Equipment*

During this month the following tasks are completed or are in progress:

- 1) Test Station - B4: A cryogenic safety review has yet to be conducted for this cryostat. Instrumentation work in the control room is proceeding more rapidly than before with additional manpower and overtime.
- 2) Work has started on assembling the 3<sup>rd</sup> 4.2K sample holder with the three high current leads. The leads were sent back to the shops for additional welding of the brass flanges as an in-house welder was not available. These have since been returned and are now being assembled. Plans now are to complete the 1.9K holder ahead of the 4.3K holder.
- 3) The third cryostat rework has been completed in Central Shops. Leak testing will be performed prior to insulation and installation. This is now expected to be completed in early March 1999.
- 4) The third magnet is in the process of being installed in the third cryostat top plate.

#### *1.3.1.2 Tests*

Cable test activity was limited to two 4.2 and two 1.9K cool-downs. A leak was discovered in the current feed-through in the Lambda plug of the 1.9K sample holder. This was repaired and the following 1.9 K test was successful, although the ambient heat load still seems excessive. During the second week of March the magnet will be removed from its cryostat and the main Lambda plate will be checked for any other sources of leaks. The heat exchanger cannot be checked internally during this time, as this would delay testing of cables that are in the pipeline. It will be planned for a time when the facility can be idled for other reasons.

Software to numerically analyze the V-I curves in a Windows environment and store the various calculated parameters in the BNL database was further upgraded after initial end-user trial runs. Additional software was also developed to generate a *Cable Test Report* from the database and

create files of the V-I waveforms that are to be shipped to CERN for every test. Such files were recently transmitted to CERN for the tests done conducted this month using protocols requested by them. Software to create files that can be directly imported to CERN's Oracle database is also being implemented. Procedures for data transmittal are being finalized with input from CERN. This activity is expected to last for a few more months. A visit to CERN is planned during the second week of March'99 to update our short term and long term plans for cable and strand test.

#### **1.4.1 Accelerator Physics**

To evaluate the impact of KEK and FNAL quad errors on proton operation at collision, a systematic tracking study of the KEK HGQ error table V2.0 and FNAL HGQ error table V2.0 was undertaken:

- mixed quadrupole distribution (KEK at Q1/Q3, FNAL at Q2)  
without correction and different correction schemes
- FNAL magnets at all location with varying  $b_6$
- comparison of  $1e3$ -turn DA with  $1e5$ -turn DA
- reversal of Q3 ends
- corrector displacement by 0.5mm

A tracking study has also been started to evaluate the impact of KEK, FNAL, and BNL magnet errors on heavy ion operation at collision. This study will determine whether IR correction is also needed for IR2 where the  $\beta^*$  will be small (0.5 m) during heavy ion operation.

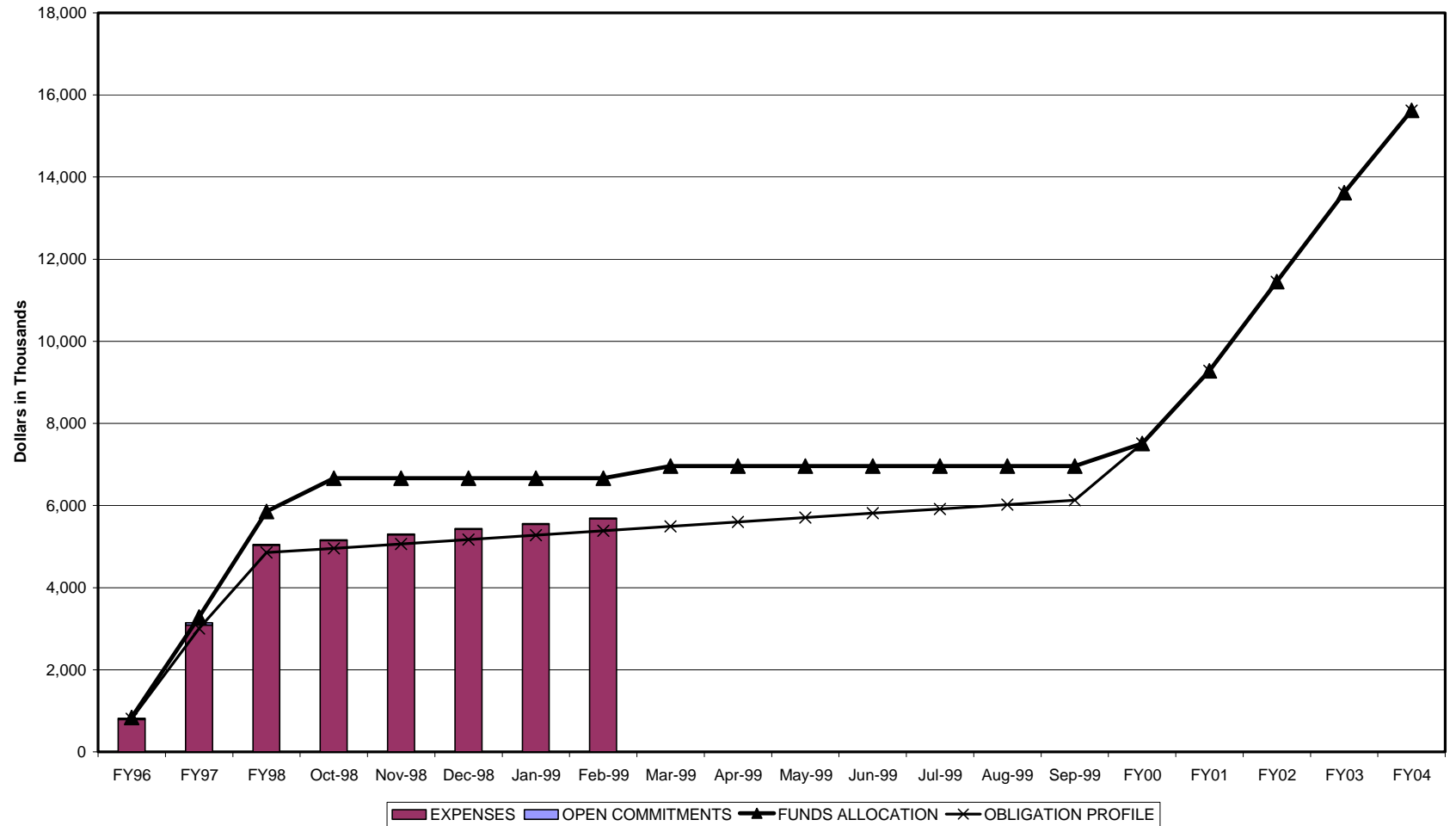
The use of the object-oriented UAL environment for LHC simulations has been demonstrated. For routine-tracking studies, the built-up of the necessary infrastructure (file system and scripts for automation) continues.

Discussions are continuing on the question of whether the BNL dipole beam tube ID is adequate to meet CERN's beam clearance requirement.

#### **1.5.2 BNL LHC Accelerator Project Management**

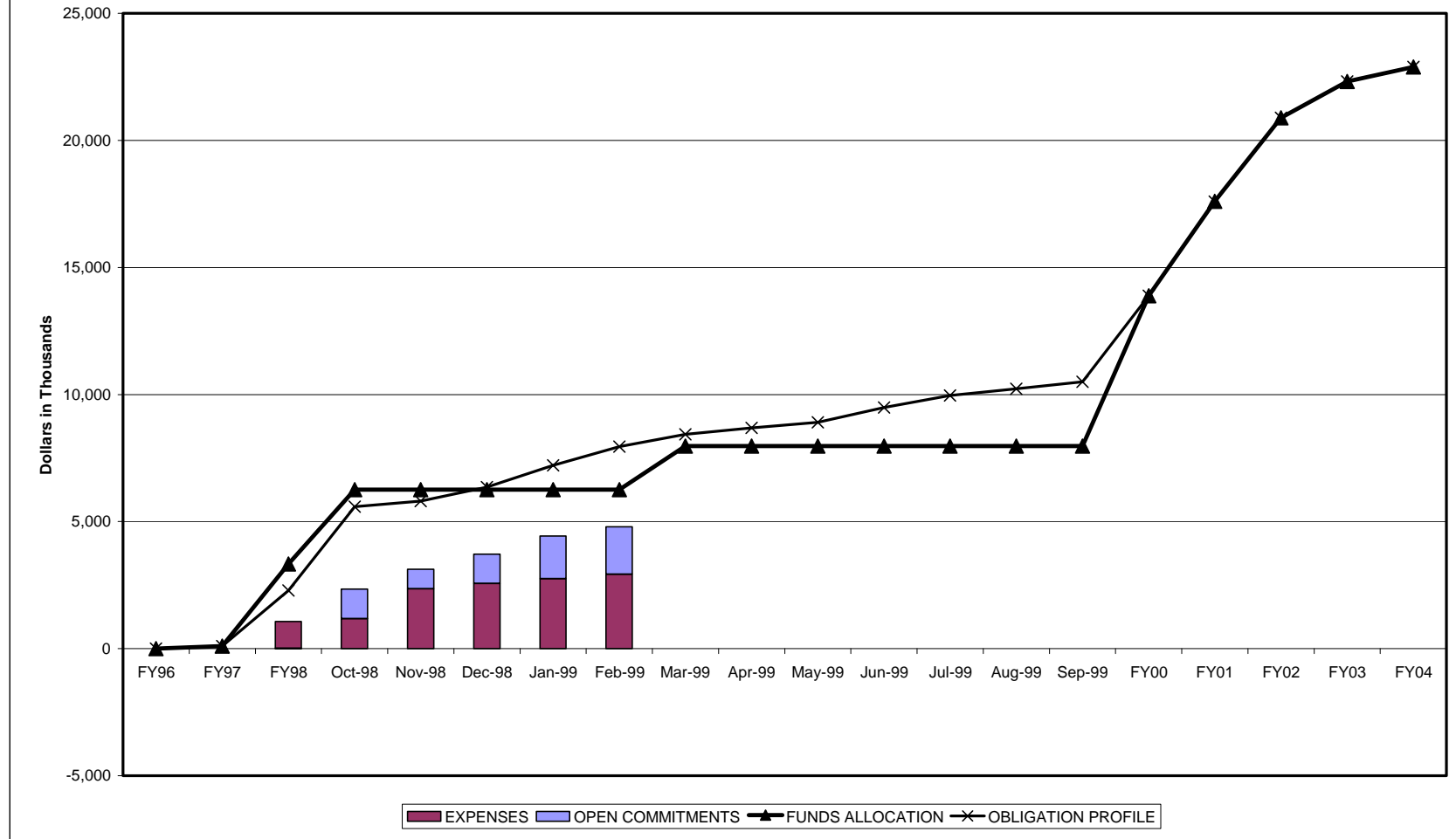
The Cost Performance Report is being generated more smoothly from the BNL accounting data and engineering progress reports. This will allow BNL staff to examine the resulting figures and plots more closely and to resolve, over the next few months, any discrepancies and inconsistencies in the data.

# BNL FINANCIAL TRACKING DATA OPERATING FUNDING



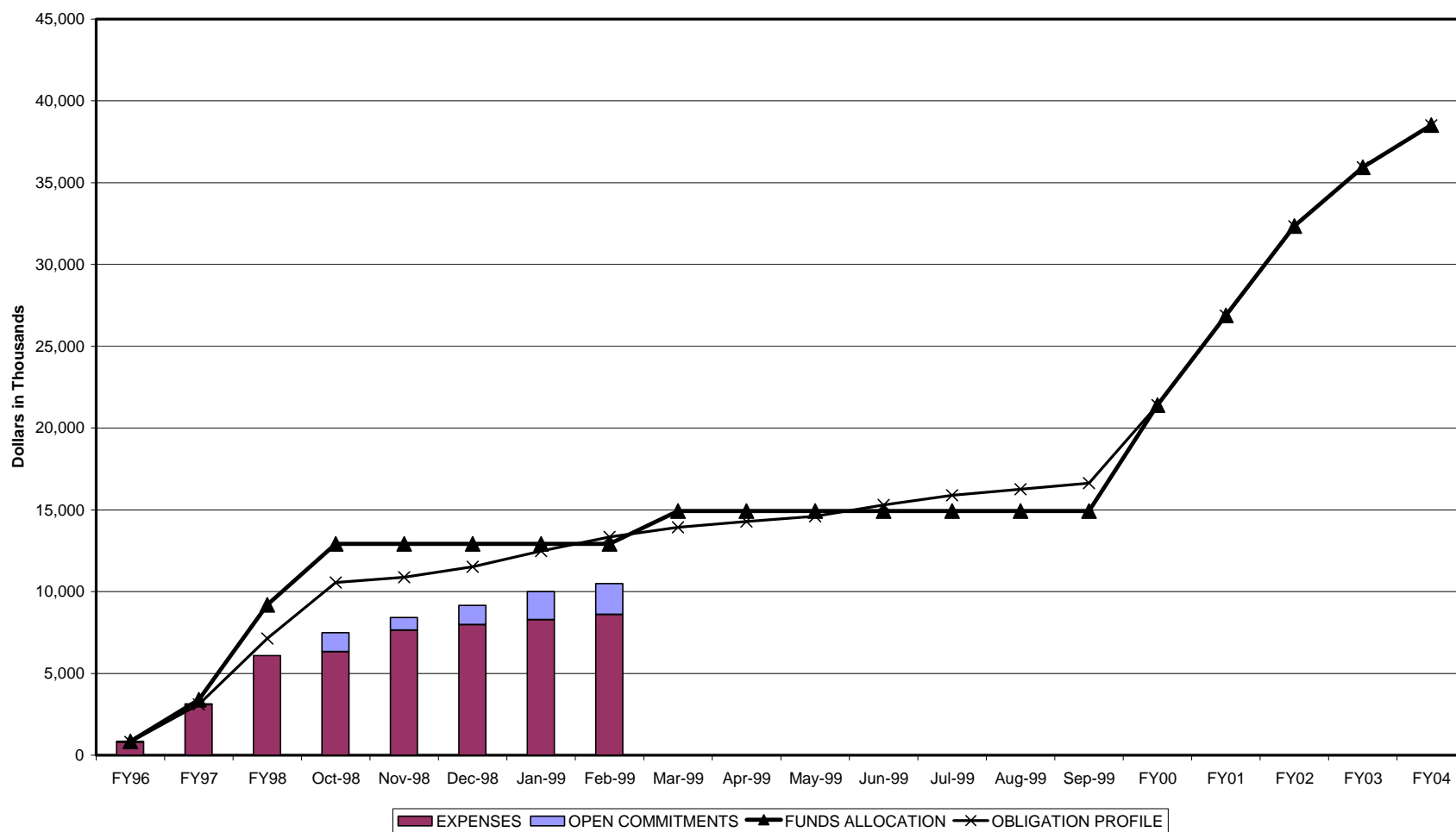
	FY96	FY97	FY98	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99	Aug-99	Sep-99	FY00	FY01	FY02	FY03	FY04
INCREMENTAL																				
FUNDS ALLOCATION	840	2,445	2,569	810					300							550	1,770	2,170	2,170	2,000
OBLIGATION PROFILE	802	2,202	1,848	106	106	106	106	106	106	106	106	106	106	106	106	1,381	1,769	2,164	2,171	2,006
EXPENSES	786	2,300	1,944	114	142	133	119	139												
OPEN COMMITMENTS	30	26	-45	-3	-1	13	5	-5												
CUMULATIVE																				
FUNDS ALLOCATION	840	3,285	5,854	6,664	6,664	6,664	6,664	6,664	6,964	6,964	6,964	6,964	6,964	6,964	6,964	7,514	9,284	11,454	13,624	15,624
OBLIGATION PROFILE	802	3,005	4,853	4,959	5,066	5,172	5,279	5,385	5,492	5,598	5,705	5,811	5,918	6,024	6,131	7,511	9,281	11,445	13,616	15,622
EXPENSES	786	3,086	5,030	5,144	5,286	5,419	5,537	5,676												
OPEN COMMITMENTS	30	57	12	8	7	20	25	20												

# BNL FINANCIAL TRACKING DATA CAPITAL FUNDING

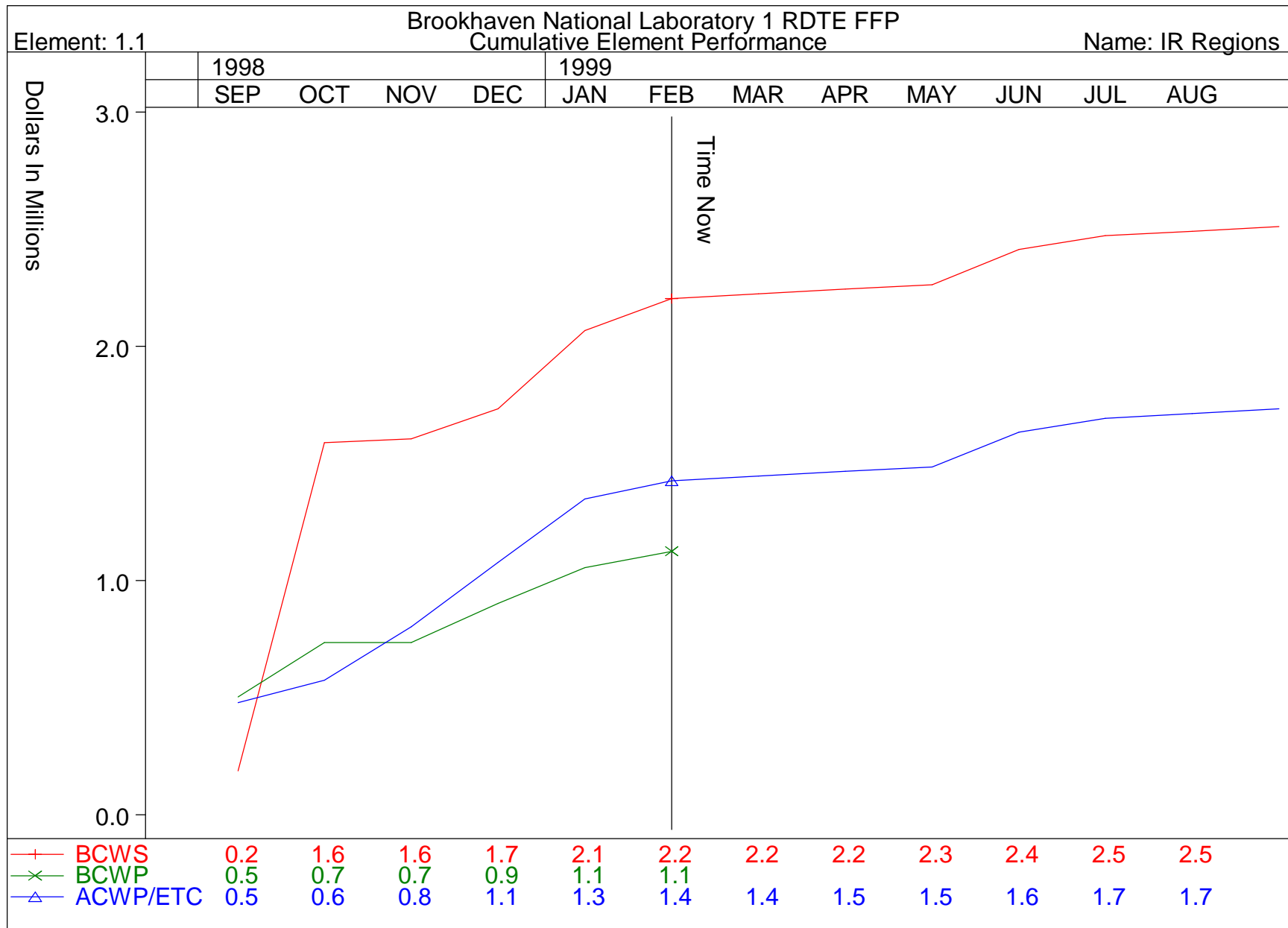


	FY96	FY97	FY98	Oct-98	Nov-98	Dec-98	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99	Aug-99	Sep-99	FY00	FY01	FY02	FY03	FY04
INCREMENTAL																				
FUNDS ALLOCATION	0	100	3,231	2,930					1,710							5,920	3,710	3,290	1,430	570
OBLIGATION PROFILE	0	100	2,186	3,306	214	549	856	745	482	247	216	593	470	266	271	3,388	3,705	3,289	1,437	568
EXPENSES	0	0	1,065	108	1,182	211	182	173												
OPEN COMMITMENTS	0	0	-12	1,177	-397	381	540	187												
CUMULATIVE																				
FUNDS ALLOCATION	0	100	3,331	6,261	6,261	6,261	6,261	6,261	7,971	7,971	7,971	7,971	7,971	7,971	7,971	13,891	17,601	20,891	22,321	22,891
OBLIGATION PROFILE	0	100	2,286	5,591	5,805	6,354	7,210	7,955	8,437	8,684	8,901	9,494	9,964	10,230	10,502	13,889	17,594	20,883	22,321	22,888
EXPENSES	0	0	1,065	1,173	2,355	2,565	2,747	2,921												
OPEN COMMITMENTS	0	0	-12	1,165	768	1,149	1,689	1,876												

# BNL FINANCIAL TRACKING DATA TOTAL FUNDING

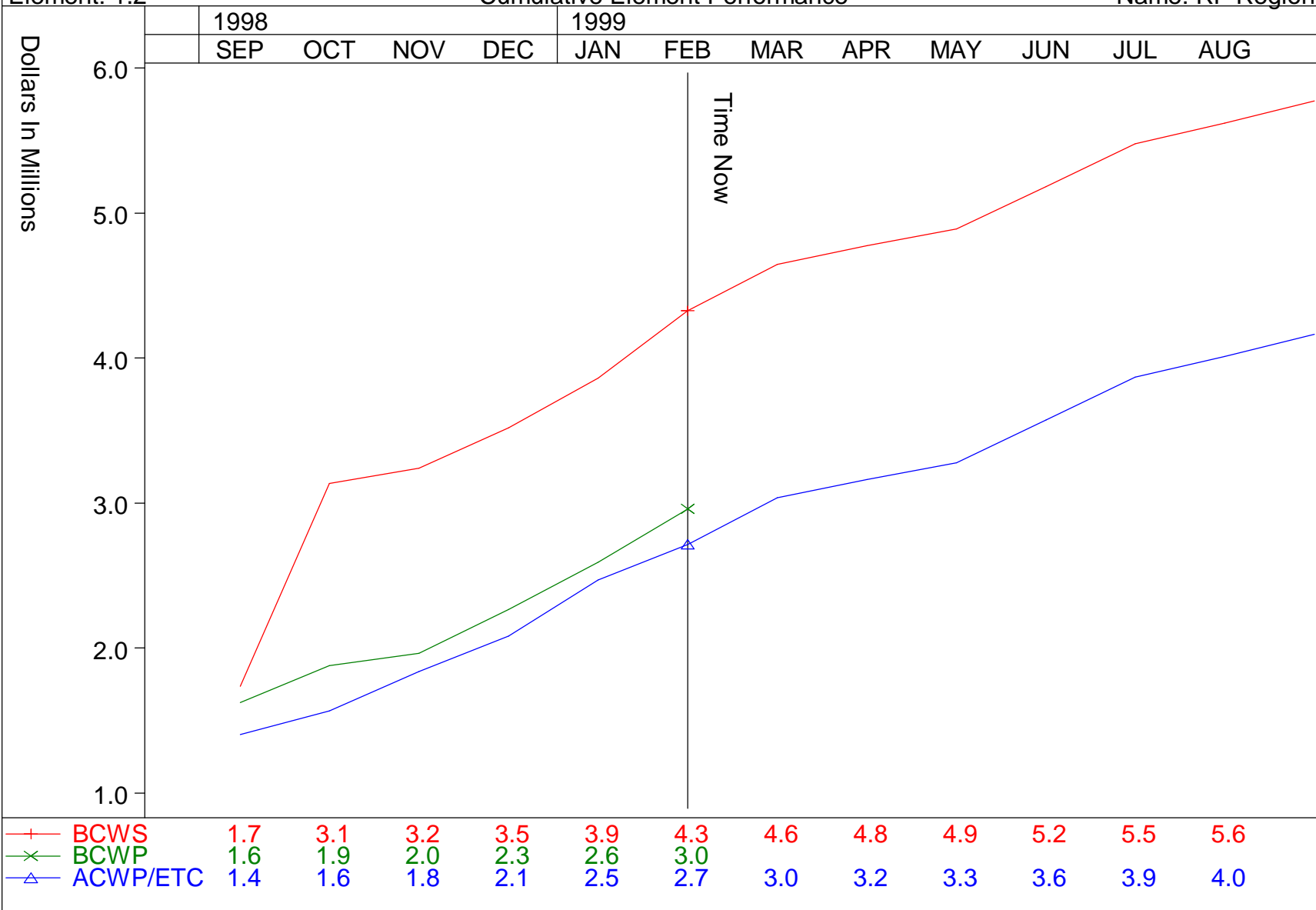


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INCREMENTAL																				
FUNDS ALLOCATION	840	2,545	5,800	3,740	0	0	0	0	2,010	0	0	0	0	0	0	6,470	5,480	5,460	3,600	2,570
OBLIGATION PROFILE	802	2,302	4,034	3,412	320	655	963	852	589	354	323	700	576	373	378	4,769	5,474	5,453	3,609	2,574
EXPENSES	786	2,300	3,009	222	1,323	343	301	312												
OPEN COMMITMENTS	30	26	-57	1,174	-398	394	544	183												
CUMULATIVE																				
FUNDS ALLOCATION	840	3,385	9,185	12,925	12,925	12,925	12,925	12,925	14,935	14,935	14,935	14,935	14,935	14,935	14,935	21,405	26,885	32,345	35,945	38,515
OBLIGATION PROFILE	802	3,105	7,139	10,551	10,871	11,526	12,489	13,340	13,929	14,283	14,606	15,305	15,881	16,254	16,632	21,401	26,875	32,328	35,937	38,510
EXPENSES	786	3,086	6,095	6,317	7,640	7,984	8,285	8,597												
OPEN COMMITMENTS	30	57	0	1,174	775	1,170	1,714	1,897												

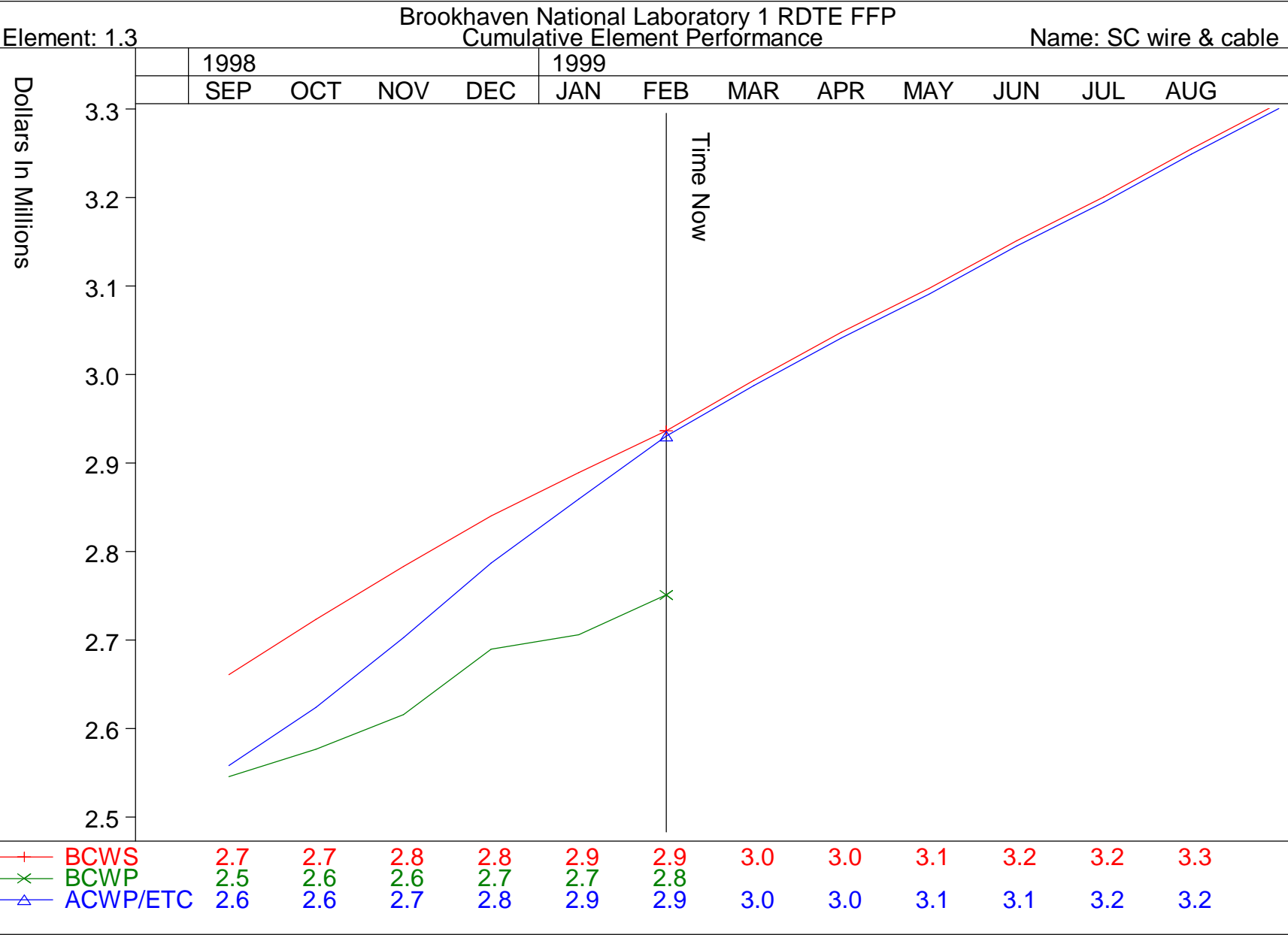


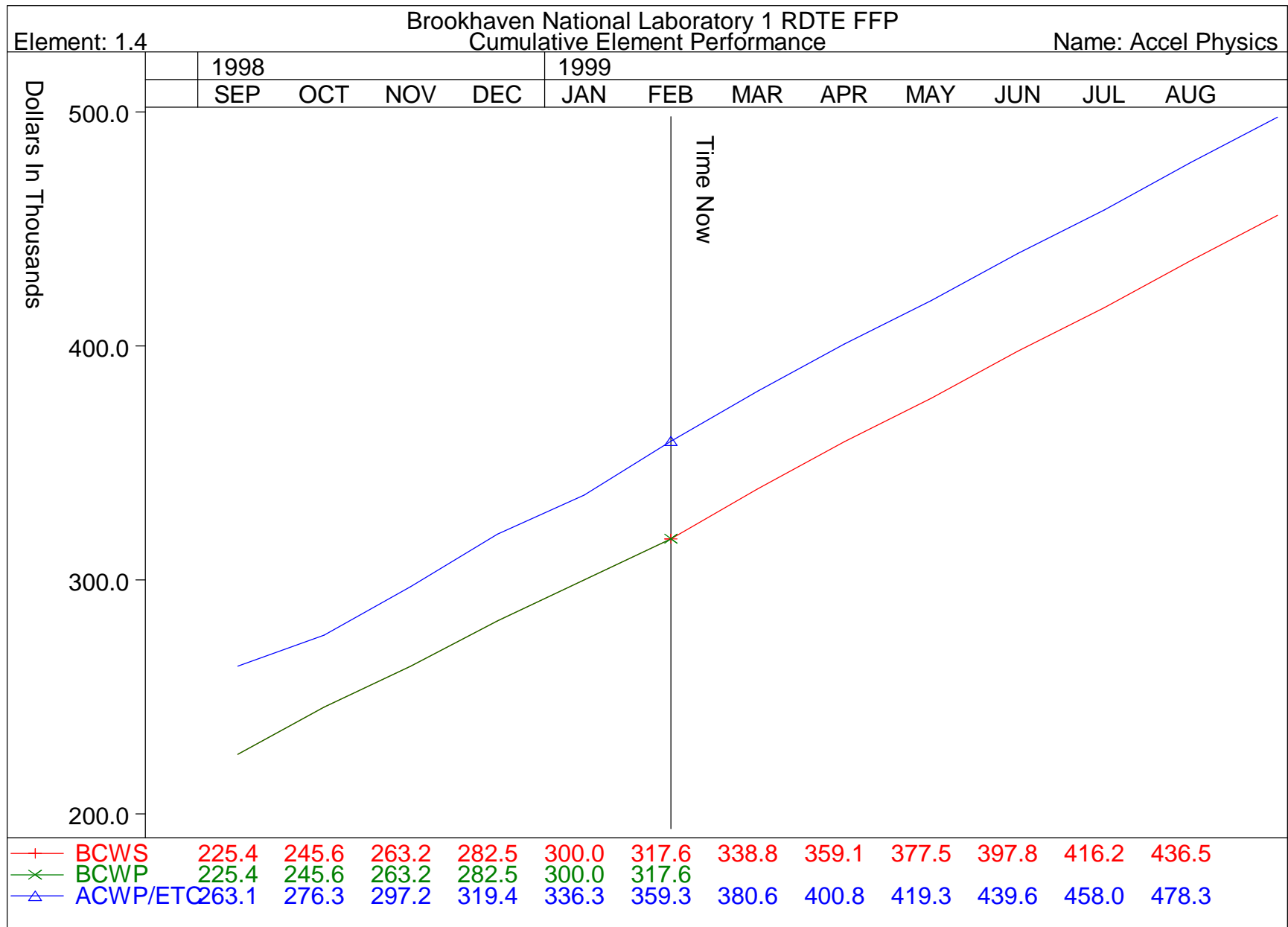
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Name: RF Region



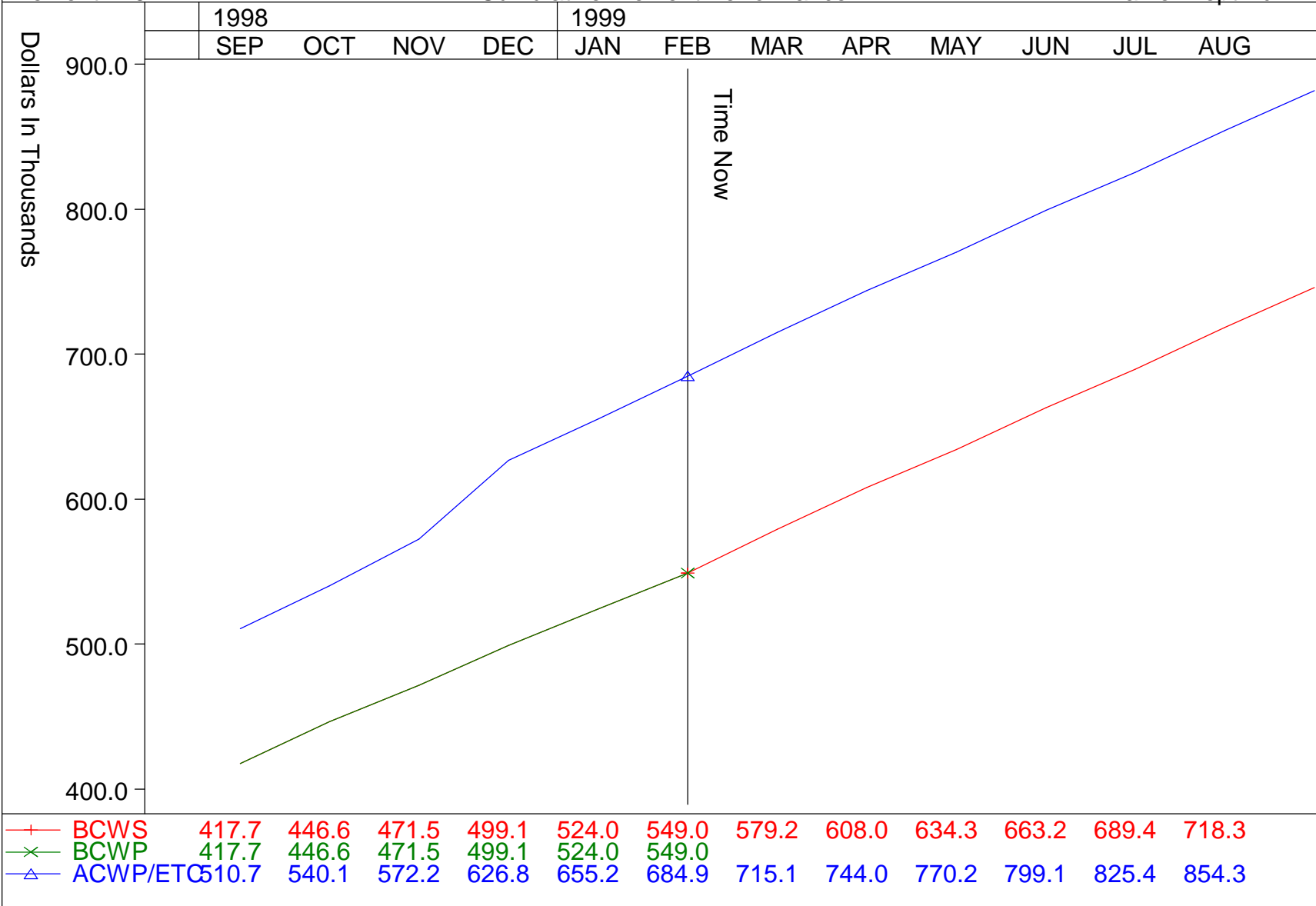






Element: 1.5.2.4

Name: Dept Admin



CLASSIFICATION (When filled in)

COST PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE												DOLLARS IN Thousands		Page 1 of 2		
<b>1. CONTRACTOR</b>				<b>2. CONTRACT</b>				<b>3. PROGRAM</b>				<b>4. REPORT PERIOD</b>				
<b>a. NAME</b> Brookhaven National Laboratory				<b>a. NAME</b> BNL LHC				<b>a. NAME</b> US LHC Accelerator Program				<b>a. FROM (YYMMDD)</b> 990201				
<b>b. LOCATION (Address and ZIP Code)</b> Bldg 902A Upton, NY 11973				<b>b. NUMBER</b> 1								<b>b. TO (YYMMDD)</b> 990227				
				<b>c. TYPE</b> FFP		<b>d. SHARE RATIO</b> 100/0 100/0		<b>b. PHASE (X one)</b> x RDT&E <input type="checkbox"/> <b>PRODUCTION</b>								
<b>5. CONTRACT DATA</b>																
<b>a. QUANTITY</b> 0/0/0	<b>b. NEGOTIATED COST</b> \$38,510.0		<b>c. EST. COST AUTH UNPRICED WORK</b> \$0.0		<b>d. TARGET PROFIT/ FEE</b> \$0.0 / 0.0%		<b>e. TARGET PRICE</b> \$38,510.0		<b>f. ESTIMATED PRICE</b> \$38,510.0		<b>g. CONTRACT CEILING</b> \$38,510.0		<b>h. ESTIMATED CONTRACT CEILING</b> \$38,510.0			
<b>6. ESTIMATED COST AT COMPLETION</b>							<b>7. AUTHORIZED CONTRACTOR REPRESENTATIVE</b>									
		<b>MANAGEMENT ESTIMATE AT COMPLETION (1)</b>		<b>CONTRACT BUDGET BASE (2)</b>		<b>VARIANCE (3)</b>		<b>a. NAME (Last, First, Middle Initial)</b> Erich Willen				<b>b. TITLE</b> BNL Project Manager				
<b>a. BEST CASE</b>		\$38,510.0						<b>c. SIGNATURE</b>				<b>d. DATE SIGNED (YYMMDD)</b> 990316				
<b>b. WORST CASE</b>		\$38,510.0														
<b>c. MOST LIKELY</b>		\$38,510.0		\$38,510.0		\$0.0										
<b>8. PERFORMANCE DATA</b>																
ITEM (1)	CURRENT PERIOD						CUMULATIVE TO DATE				REPROGRAMMING ADJUSTMENTS		AT COMPLETION			
	BUDGETED COST		ACTUAL COST WORK PERFORMED (4)	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED (9)	VARIANCE		COST VARIANCE (12)	BUDGET (13)	BUDGETED (14)	ESTIMATED (15)	VARIANCE (16)	
	WORK SCHEDULED (2)	WORK PERFORMED (3)		SCHEDULE (5)	COST (6)	WORK SCHEDULED (7)	WORK PERFORMED (8)		SCHEDULE (10)	COST (11)						
<b>a. WORK BREAKDOWN STRUCTURE ELEMENT</b>																
1.1 - IR Regions	2	136.1	69.8	77.8	-66.3	-8.0	2,203.9	1,124.9	1,425.5	-1,079.1	-300.6			5,150.6	4,372.2	778.4
1.1.1 - IR Quadrupoles	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
1.1.2 - IR Dipoles	3	136.1	69.8	77.8	-66.3	-8.0	2,203.9	1,124.9	1,425.5	-1,079.1	-300.6			5,150.6	4,372.2	778.4
1.1.2.1 - Tooling	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.6	0.0	-18.6			158.8	177.4	-18.6
1.1.2.2 - D1 Production	4	46.9	15.6	22.4	-31.3	-6.9	375.6	191.8	324.3	-183.8	-132.5			684.9	633.6	51.3
1.1.2.3 - D2 Production	4	72.2	54.2	49.5	-18.0	4.7	1,690.9	844.0	1,015.4	-846.9	-171.4			2,453.9	1,778.4	675.5
1.1.2.4 - Magnet Testing	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			527.2	527.2	0.0
1.1.2.5 - EDIA	4	17.0	0.0	5.8	-17.0	-5.8	137.5	89.1	67.2	-48.4	21.9			1,325.9	1,255.6	70.3
1.2 - RF Region	2	464.4	368.8	246.0	-95.7	122.8	4,325.3	2,959.2	2,714.3	-1,366.1	244.9			11,685.9	10,074.9	1,611.0
1.2.1 - RF Region Dipol	3	464.4	368.8	246.0	-95.7	122.8	4,325.3	2,959.2	2,714.3	-1,366.1	244.9			11,685.9	10,074.9	1,611.0
1.2.1.1 - Tooling	4	71.9	106.4	51.0	34.4	55.4	330.7	307.0	253.6	-23.7	53.4			861.8	784.8	77.0
1.2.1.2 - Prototypes	4	8.7	8.5	41.5	-0.2	-32.9	178.3	102.2	178.1	-76.0	-75.8			252.8	252.6	0.2
1.2.1.3 - D3 Production	4	244.3	47.0	38.9	-197.2	8.2	643.9	388.7	399.6	-255.2	-10.9			1,292.8	1,048.5	244.3
1.2.1.4 - D4 Production	4	33.5	70.8	26.7	37.3	44.1	1,168.9	630.8	748.0	-538.2	-117.2			1,791.8	1,370.9	421.0
1.2.1.5 - Magnet Testing	4	0.0	0.0	0.0	0.0	0.0	68.3	33.4	0.0	-34.9	33.4			941.0	872.7	68.3

CLASSIFICATION (When filled in)

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COST PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE												DOLLARS IN Thousands		Page 2 of 2		
8. PERFORMANCE DATA																
ITEM  (1)	CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAMMING		AT COMPLETION			
	BUDGETED COST		ACTUAL COST WORK PERFORMED (4)	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED (9)	VARIANCE		ADJUSTMENTS		BUDGETED (14)	ESTIMATED (15)	VARIANCE (16)	
	WORK SCHEDULED (2)	WORK PERFORMED (3)		SCHEDULE (5)	COST (6)	WORK SCHEDULED (7)	WORK PERFORMED (8)		SCHEDULE (10)	COST (11)	COST VARIANCE (12)	BUDGET (13)				
<b>a. WORK BREAKDOWN STRUCTURE ELEMENT</b>																
1.2.1.6 - EDIA	4	106.0	136.0	88.0	30.0	48.1	1,935.3	1,497.2	1,135.0	-438.1	362.1			6,545.7	5,745.5	800.2
1.3 - SC wire & cable	2	47.5	45.0	71.1	-2.6	-26.2	2,936.6	2,750.9	2,930.6	-185.7	-179.7			8,854.1	8,848.1	6.0
1.3.1 - SC Testing	3	47.5	45.0	71.1	-2.6	-26.2	2,936.6	2,750.9	2,930.6	-185.7	-179.7			8,854.1	8,848.1	6.0
1.3.1.1 - Tooling & Equip	4	0.6	1.9	17.5	1.3	-15.6	695.0	612.3	724.0	-82.7	-111.7			695.0	724.0	-29.0
1.3.1.2 - Tests	4	21.9	16.8	25.0	-5.2	-8.2	591.4	481.7	396.2	-109.7	85.5			4,868.9	4,673.8	195.1
1.3.1.3 - EDIA	4	25.0	26.3	28.7	1.3	-2.4	1,124.7	1,131.3	1,284.8	6.7	-153.5			2,764.6	2,924.7	-160.1
1.3.1.4 - FY96 Actuals	4	0.0	0.0	0.0	0.0	0.0	525.6	525.6	525.6	0.0	0.00			525.6	525.6	0.00
1.4 - Accel Physics	2	17.5	17.5	23.1	0.0	-5.6	317.6	317.6	359.3	0.0	-41.8			1,705.8	1,747.6	-41.8
1.4.1 - BNL Physics	3	17.5	17.5	23.1	0.0	-5.6	317.6	317.6	359.3	0.0	-41.8			1,705.8	1,747.6	-41.8
1.4.1.1 - Physics Anal	4	17.5	17.5	23.1	0.0	-5.6	317.6	317.6	359.3	0.0	-41.8			1,705.8	1,747.6	-41.8
1.5 - Project Mgt	2	77.0	77.0	56.6	0.0	20.4	1,504.3	1,504.3	1,459.5	0.0	44.8			6,028.5	5,983.8	44.8
1.5.1 - US Proj Mgt	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
1.5.2 - BNL Proj Mgt	3	77.0	77.0	56.6	0.0	20.4	1,504.3	1,504.3	1,459.5	0.0	44.8			6,028.5	5,983.8	44.8
1.5.2.1 - EDIA	4	16.7	16.7	19.8	0.0	-3.1	348.8	348.8	333.2	0.0	15.6			1,652.1	1,636.5	15.6
1.5.2.2 - Travel	4	6.7	6.7	6.3	0.0	0.4	153.5	153.5	140.2	0.0	13.3			607.6	594.4	13.3
1.5.2.3 - Generic Support	4	28.6	28.6	0.8	0.0	27.8	383.0	383.0	231.1	0.0	151.9			1,452.5	1,300.6	151.9
1.5.2.4 - Dept Admin	4	24.9	24.9	29.7	0.0	-4.7	549.0	549.0	684.9	0.0	-135.9			2,246.3	2,382.3	-135.9
1.5.2.4.1 - Administrative	5	6.7	6.7	8.7	0.0	-2.0	147.5	147.5	241.9	0.0	-94.4			603.5	697.9	-94.4
1.5.2.4.2 - Building Electr	5	10.2	10.2	12.7	0.0	-2.5	225.4	225.4	260.3	0.0	-35.0			922.0	957.0	-34.9
1.5.2.4.3 - Other Direct Co	5	8.0	8.0	8.2	0.0	-0.2	176.1	176.1	182.7	0.0	-6.6			720.8	727.4	-6.6
1.5.2.5 - FY96 Actuals	4	0.0	0.0	0.0	0.0	0.0	70.0	70.0	70.0	0.0	-0.00			70.0	70.0	-0.00
OV - OVERHEAD	2	28.3	13.3	1.6	-15.0	11.7	293.2	174.3	132.6	-118.9	41.8			497.5	336.8	160.7
<b>b. COST OF MONEY</b>	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
<b>c. GENERAL &amp; ADMINISTRATIVE</b>	2	80.8	75.4	36.8	-5.4	38.6	1,759.3	1,480.0	1,489.4	-279.3	-9.4			4,587.5	4,317.6	269.9
<b>d. UNDISTRIBUTED BUDGET</b>	2													0.0	0.0	0.0
<b>e. SUBTOTAL (Performance Measurement Baseline)</b>		851.6	666.7	513.0	-184.9	153.6	13,340.2	10,311.2	10,511.2	-3,029.0	-200.0	0.0	0.0	38,510.0	35,681.0	2,829.0
<b>f. MANAGEMENT RESERVE</b>	2												0.0	0.0		
<b>g. TOTAL</b>		851.6	666.7	513.0	-184.9	153.6	13,340.2	10,311.2	10,511.2	-3,029.0	-200.0	0.0	0.0	38,510.0		
<b>9. RECONCILIATION TO CONTRACT BUDGET BASE</b>																
<b>a. VARIANCE ADJUSTMENT</b>										0.0	0.0					
<b>b. TOTAL CONTRACT VARIANCE</b>										-3,029.0	-200.0			38,510.0	35,681.0	2,829.0

CLASSIFICATION (When filled in)